Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office
TOP3–00198

One-Dimensional Design and Analysis Codes for Compressors

Technology

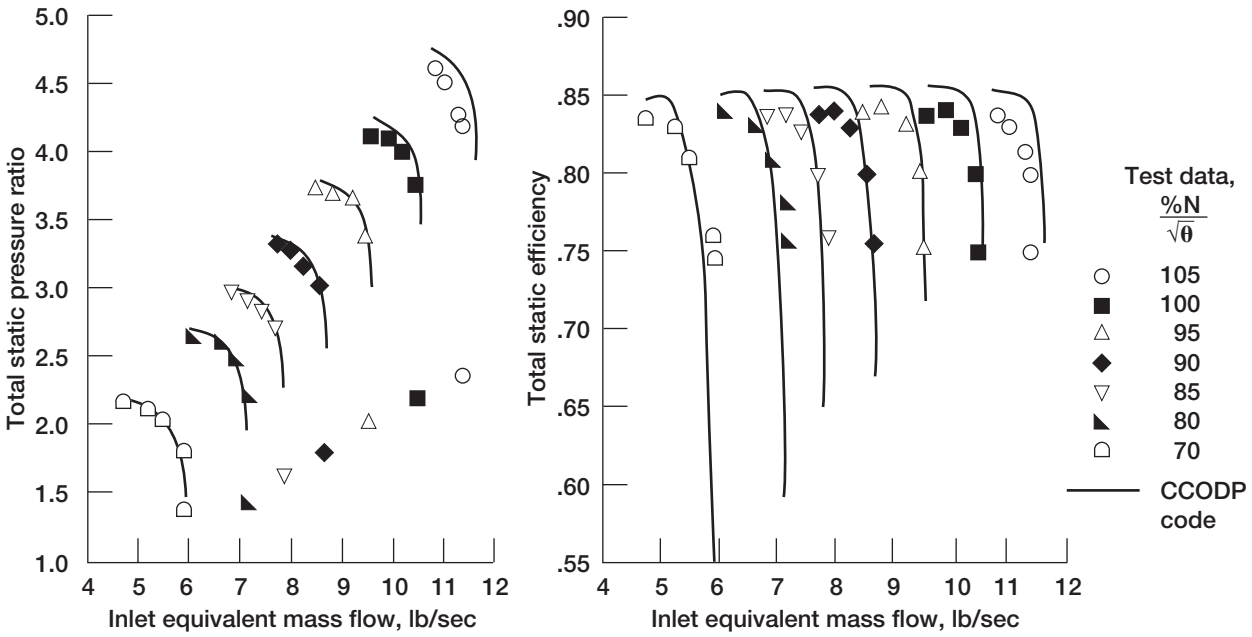
One-dimensional (1–D) software codes for design and analysis of compressor blading.

Benefits

- Higher efficiencies
- Faster design cycle times
- Lower direct operating costs
- Improved reliability

Commercial Applications

- Conceptual design of compressors
- Sizing, number of stages, and weight estimates
- Preliminary performance maps for operation
- Development of commercial pump and compressor designs
- Aircraft propulsion
- Auxiliary power
- Centrifugal compressors
- Turbochargers



Centrifugal compressor off-design code CCODP predictions (4:1 pressure ratio compressor; 50 ° backswept impeller with splitters; and vaned island diffuser).

One-Dimensional Turbomachinery Analysis Codes

(a) Code descriptions

Code	Brief code description
CSPAN	1–D axial compressor design code
STGSTK	1–D axial compressor off-design code (performance maps)
QUIK	Centrifugal compressor design program
CCODP	Centrifugal compressor off-design program (performance maps)

(b) Code descriptions

Conceptual design stage	Code characteristics	Typical trade studies	Aerothermodynamic uses
CSPAN STGSTK QUIK CCODP	Robustness; Minimal input; User friendly; Extremely fast computationally; Reasonable accuracy	Compressor sizing; Number of stages; Weight estimates; rpm and material requirements	Stage loading; Average blade row turning; Efficiency

(c) Experience and time requirements

Code	Typical user experience	Time required to learn code	Set-up time	Times for average case	Computer required	Where to obtain code
CSPAN	Low	<1 wk	~minutes	<1 second	PC	GRC SR
STGSTK	Low	~1 wk	~minutes	<1 second	PC	GRC SR
QUIK	Low	~1 wk	~minutes	~seconds	PC	GRC SR
CCODP	Low	~1 wk	~minutes	~seconds	PC	GRC SR

Technology Description

One-dimensional methods for designing and analyzing turbomachinery blading have been developed over several decades. These codes can be used to determine stage loading, average blade row turning, and efficiency. They can be used to estimate the performance, pressure loads, and conceptual flow path and blading. The codes were developed as conceptual design codes capable of sizing and estimating the number of stages, over all weight, revolutions per minute, and material specification.

Over a 30-year period, NASA Glenn Research Center has conducted substantial compressor research as a basis for development of the 1–D codes. These codes are robust, extremely fast computationally, and reasonably accurate. They require minimal input and are best used to analyze and compute conceptual and preliminary designs of compressors.

Options for Commercialization

The codes may be used to develop and enhance design tools for commercial applications and can be acquired from our NASA Glenn Research Center Software Repository (SR) at https://www. technology.grc.nasa.gov/software.

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Key Words

Compressor performance

Compressor design tools